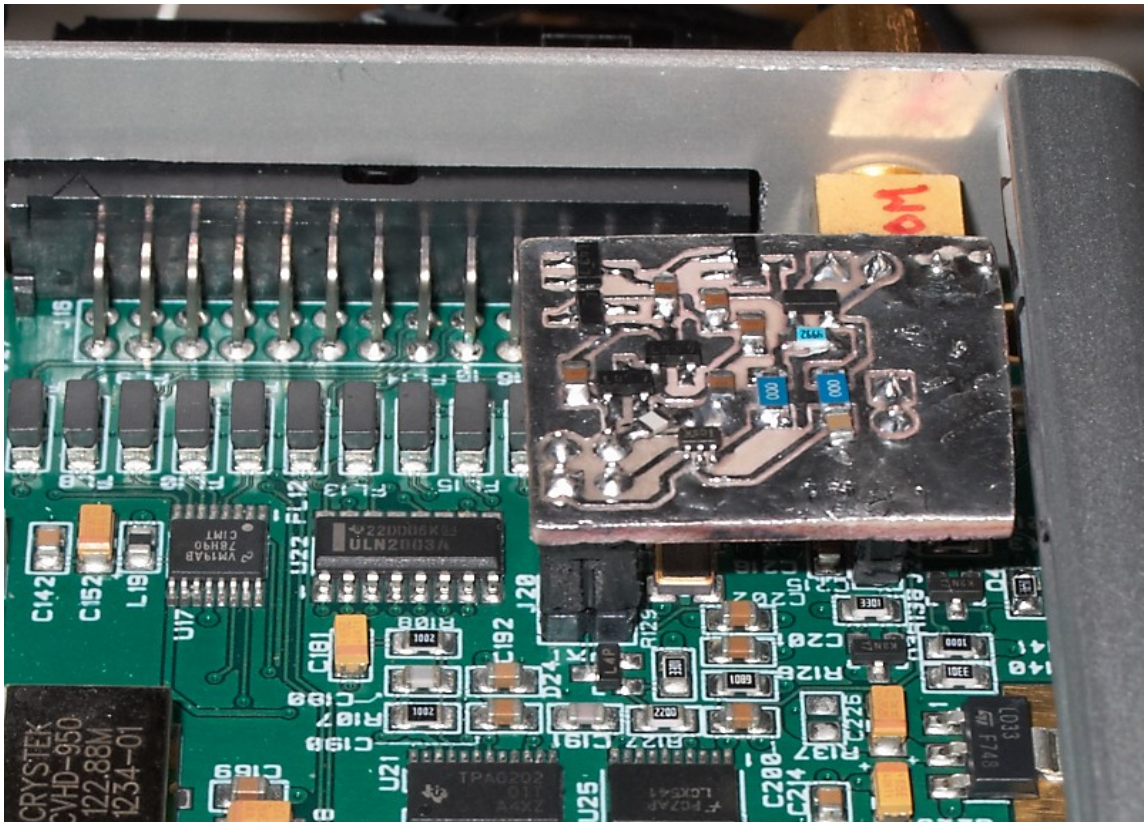
Hermes/ Angela Autoswitched External 10MHz Reference



Recently, I built a small schmitt trigger buffer board for taking the slow edge speed 10MHz signal from the differential pair circuit in the Hermes. This buffer eliminated the "slips" when using the external 10MHz. Many users have sent me emails asking if I could come up with a autoswitched version which would use the internal 10MHz TXCO if the external signal is not present. Here is a list of possible improvements with a new Autoswitched design:

1) Provide schmitt buffering of differential pair signals to drive the FPGA with clean digital signal.
2) Proved 3.3V level conversion to the diff pair signal. This gives proper noise margins at the FPGA and also eliminate any overvoltage driving the FPGA.
3) Generate a switched 3.3V power to supply to the internal TXCO when external is not present.

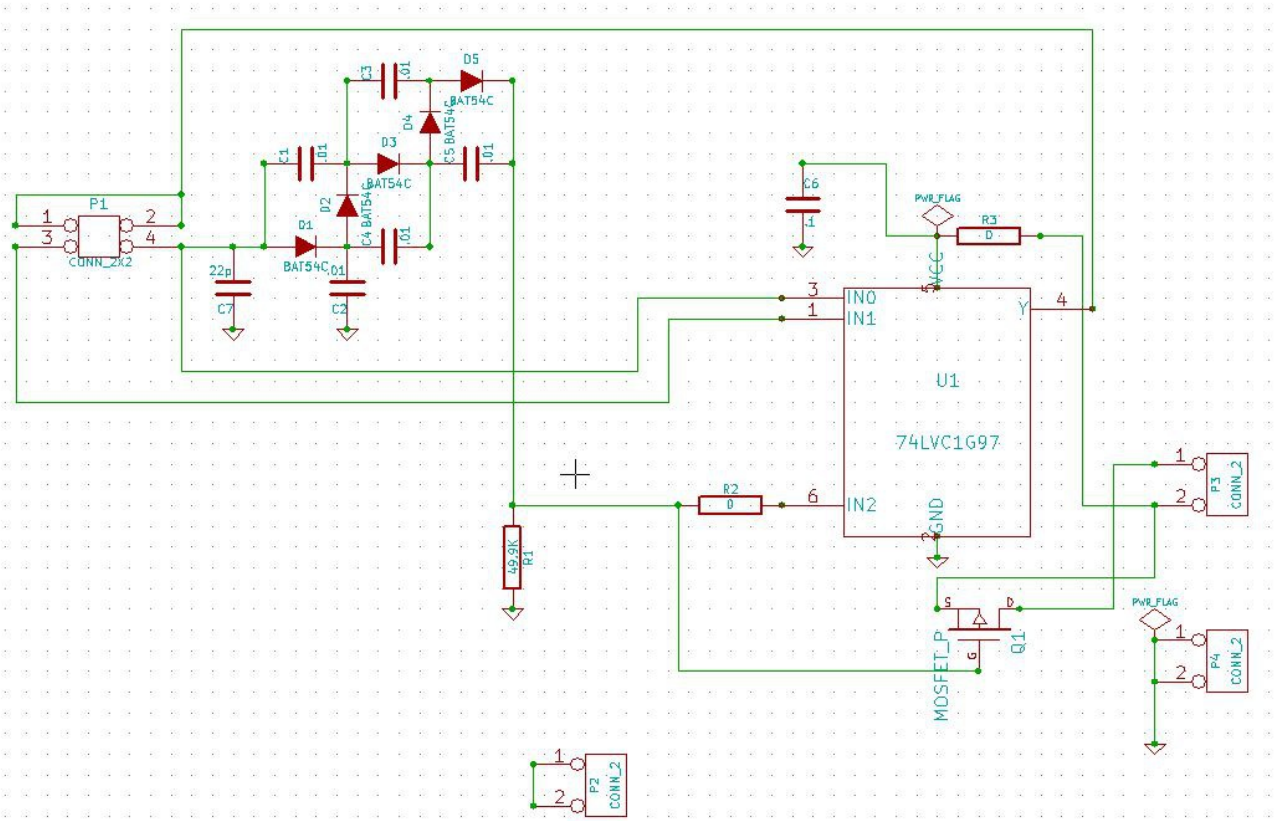
Using a schmitt trigger input gate like the 74LVC1G14 still requires a fairly good output from the differential pair in the Hermes 10MHz buffer stage. The positive going threshold spec for 3V VCC is 1.5V to 1.87V. Getting 1.87V out of the stock diff pair circuit on the Hermes may be on the edge. The diff pair bias resistor may be adjusted to make this reliable. Low going threshold spec is .84 to 1.19V so getting a good signal from the diff pair crossing .84V and 1.87V is required. With either the schmitt trigger buffer or autoswitched circuit the on board differential pair needs a resistor change in the collector drive. The Hermes came with a 240ohm resistor and was swapped with a 365ohm. Several values were tried from 300 to 400 ohms and 365 seemed to be the best choice for noise margins.

Thinking about an auto switchover 10MHz circuit I remember I had some 74LVC97 chips which

is basicly a digital mux with built in schmitt triggers on all inputs. This would be ideal and simple device if a reliable EXT10MHZ clock detector circuit could be attached.

A circuit was designed and prototypes built. A KICAD layout was made and a small circuit board was etched and built.

The circuit schematic is shown below:



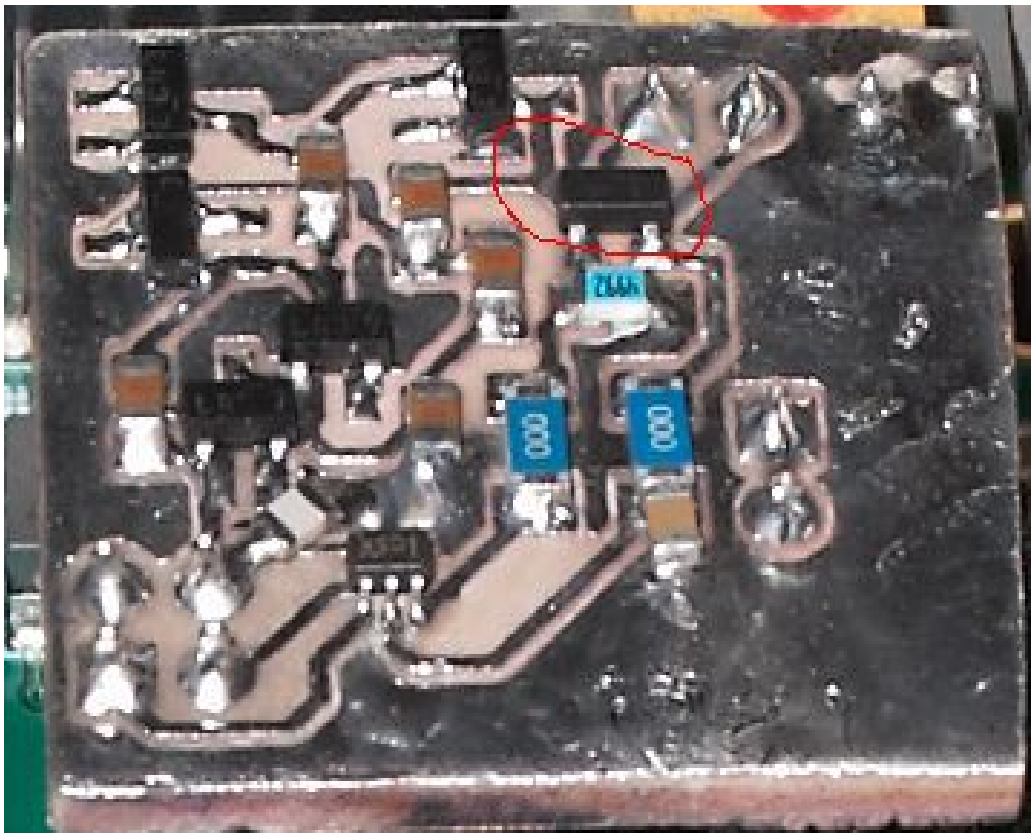
The detector would need to drive the select line and also enough voltage for use as a gate drive for a P channel power SW for the power feed to the INT10MHz oscillator.

Using Cockcroft-Walton X3 voltage multiplier on the diff pair output a large enough DC output can be made for direct use by the MUX and the power SW FET.
http://www.allaboutcircuits.com/vol_3/chpt_3/8.html
and removing the first cap and diode (since the diff pair signal is above ground).
This is 5 caps (.01uF OK) and 5 diodes.

The output is loaded with 49K or so to control switcher time to INT10MHZ. (No load took many seconds to switch).

This output is then used as the clock MUX select control (0 is INT10MHz, 1 is EXT10MHZ).

Also the signal is used to drive the gate of a P-ch Mosfet (source at 3.3V, and drain to power INT10MHZ oscillator).



Circuit was simulated with LTSpice and a rough 1" X .7" single sided Layout was done on KICAD.
A prototype was manually etched and built (wrong diode footprint so used leaded ones :)).
The prototype seems to work perfect. Switches back and forth in a sec or so. The loaded control voltage is measured just above 3V or so providing good swing for the MUX and FET.

Three more prototypes were manually etched and built using SMT parts. My 3 Hermes all have this auto switched 10MHz board installed and working great.

73, Mike Collins KF4BQ